

Improving early detection of aquatic animal disease

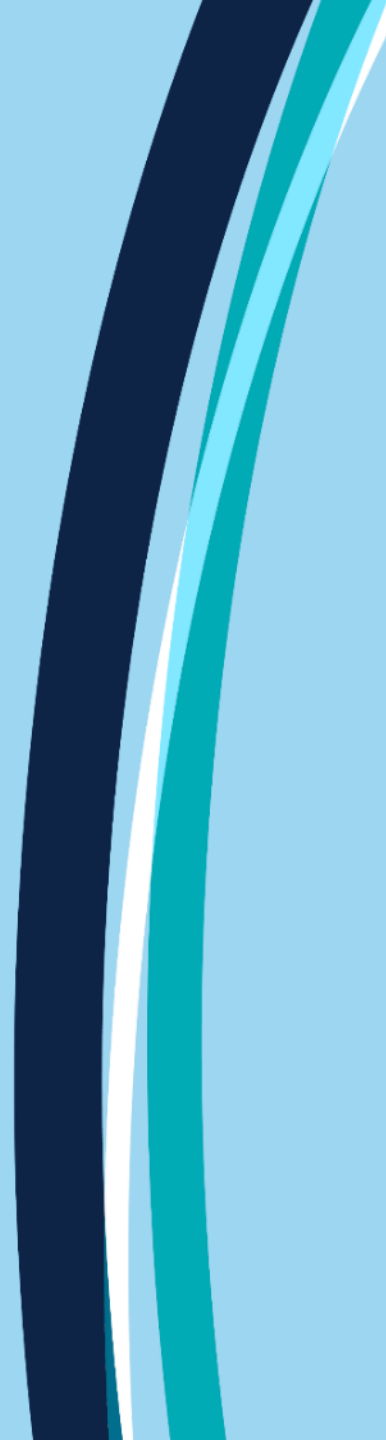
Prof Edmund Peeler



We are Cefas

Cefas is the **C**entre for **E**nvironment, **F**isheries, and **A**quaculture **S**cience.

We are an Executive Agency of Defra, the UK government's Department of Environment, Food and Rural Affairs.



Outline

- Global context
- Definitions
- Why is early detection of disease important?
- Case study: freedom from VHSV
- Surveillance systems assessment
- Barriers to disease reporting
- How can early detection be improved?



Global context



- Expansion of aquaculture: new regions, new species, new and growing trade patterns
- Emergence of new diseases, transboundary diseases and epidemics of existing diseases
- Sanitary and phytosanitary agreement (WTO) allows infectious disease to remain a barrier to free trade

Early detection system (EDS)

WOAH definition

means a system....which ensures:

- the rapid recognition of signs that are suspicious of a listed disease, or an emerging disease, or unexplained mortality, in aquatic animals in an aquaculture establishment or in the wild, **and**
- the rapid communication of the event to the Competent Authority, with the aim of activating an investigation by the Aquatic Animal Health Services with minimal delay.

Farmer
reporting

Reporting by
AAH
professionals

Routine
farms visits
by CA

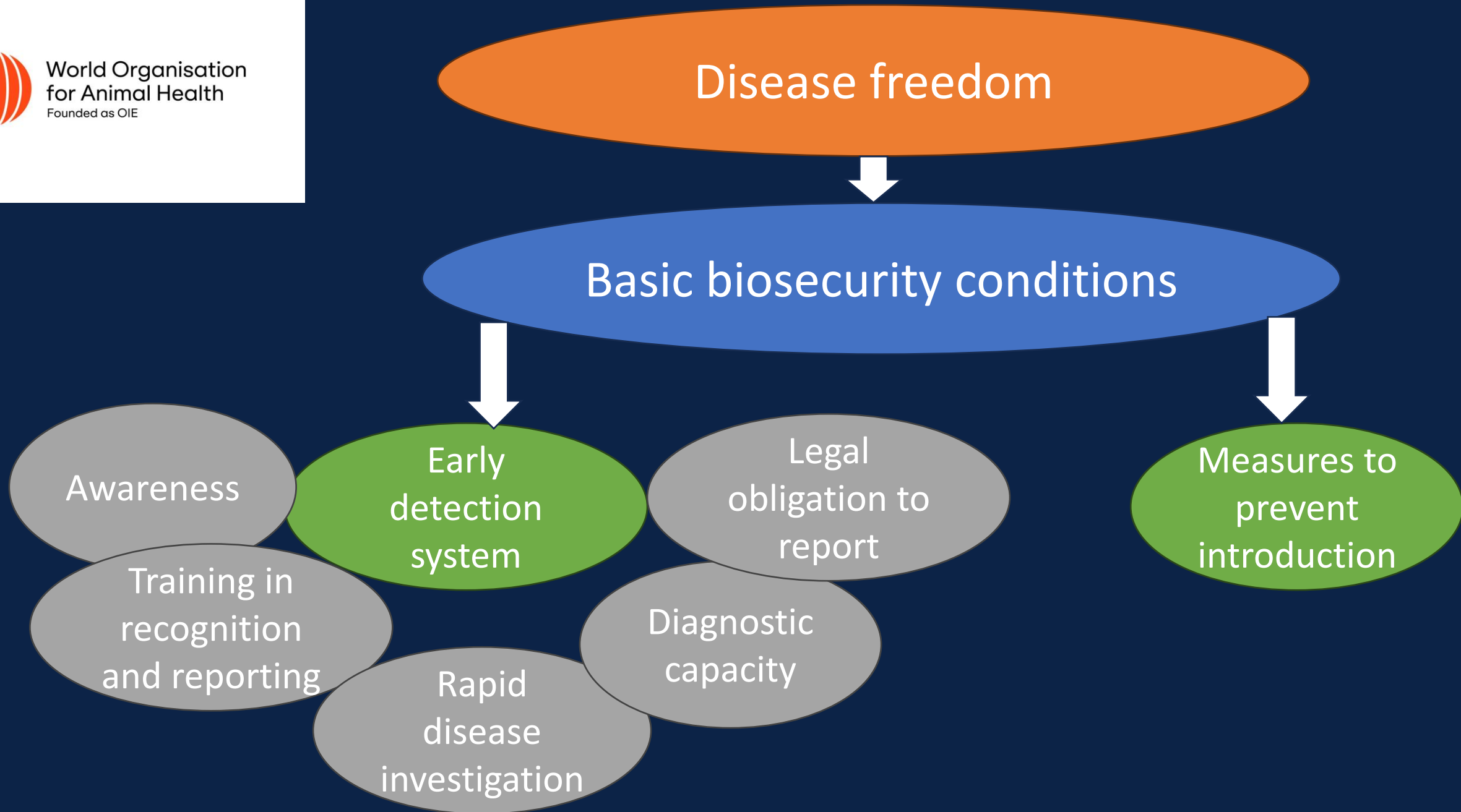
Inspections at
markets

**Why is early
detection of
disease
important?**

Three curved, overlapping lines in dark blue, light blue, and white, sweeping from the top right towards the bottom left, set against a solid teal background.



World Organisation
for Animal Health
Founded as OIE



Freedom from viral haemorrhagic septicaemia

Basis for UK's claim

- WOAHP pathway – historic freedom
- Restrictions on importation of live susceptible species and uneviscerated fish carcasses
- VHS is a listed disease – legal obligation to report
- High level of awareness amongst farmers (annual visits by fish health inspectors)
- Fish health inspectors trained to detect and investigate suspect VHS
- Govt lab capable of investigating suspect outbreaks (evidenced by investigations)
- Laboratory capacity for detection of VHSV



CHAPTER 33.

An Act to prevent the spreading of disease among salmon and freshwater fish in Great Britain. A.D. 1937.
[10th June 1937.]

BE it enacted by the King's most Excellent Majesty, by and with the advice and consent of the Lords Spiritual and Temporal, and Commons, in this present Parliament assembled, and by the authority of the same, as follows:—

1.—(1) It shall not be lawful to import or bring into Great Britain any live fish of the salmon family. Restriction on importation of live fish and eggs of fish.

(2) It shall not be lawful to import or bring into Great Britain any live freshwater fish or live eggs of fish of the salmon family, or of freshwater fish, unless the fish or eggs are consigned to a person licensed under this section and the licence is produced at the time of the delivery under the Customs Acts of the entry of the consignment.

(3) The Minister of Agriculture and Fisheries (in this Act referred to as "the Minister") may grant a licence to any person to have consigned to him such fish or eggs as are mentioned in the last foregoing subsection, and the following provisions shall have effect in relation to such licences, that is to say:—

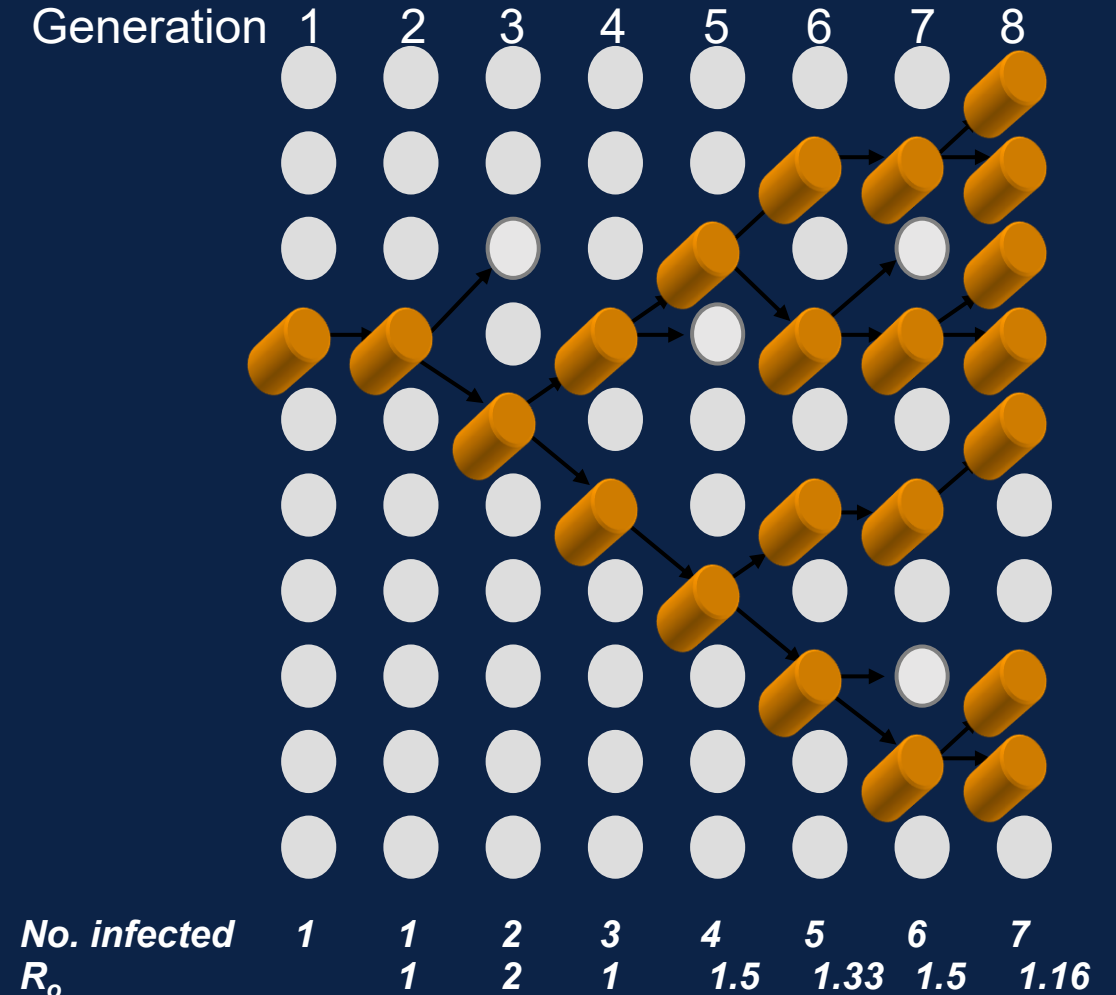
(a) A licence may be granted subject to such conditions as the Minister thinks fit as to the quantities or kinds of fish or eggs which may be imported or brought in under the licence,

The narrow window of opportunity

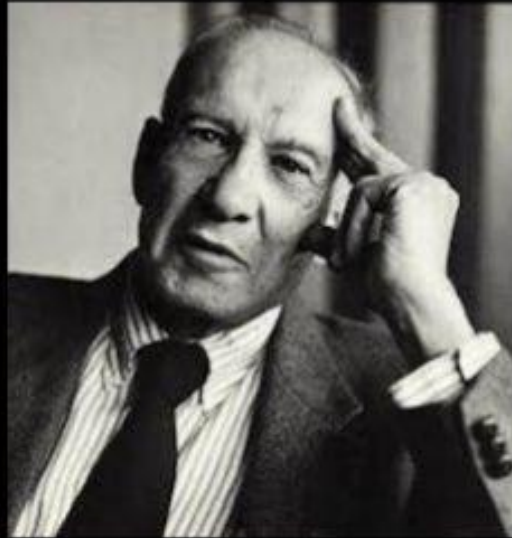
... to control an introduced or emerging disease

Many diseases will spread rapidly with live animal movements and through water.

Early detection is critical to a successful and cost-effective response to the detection of an introduced or emerging disease



**How can
surveillance
systems be
assessed?**

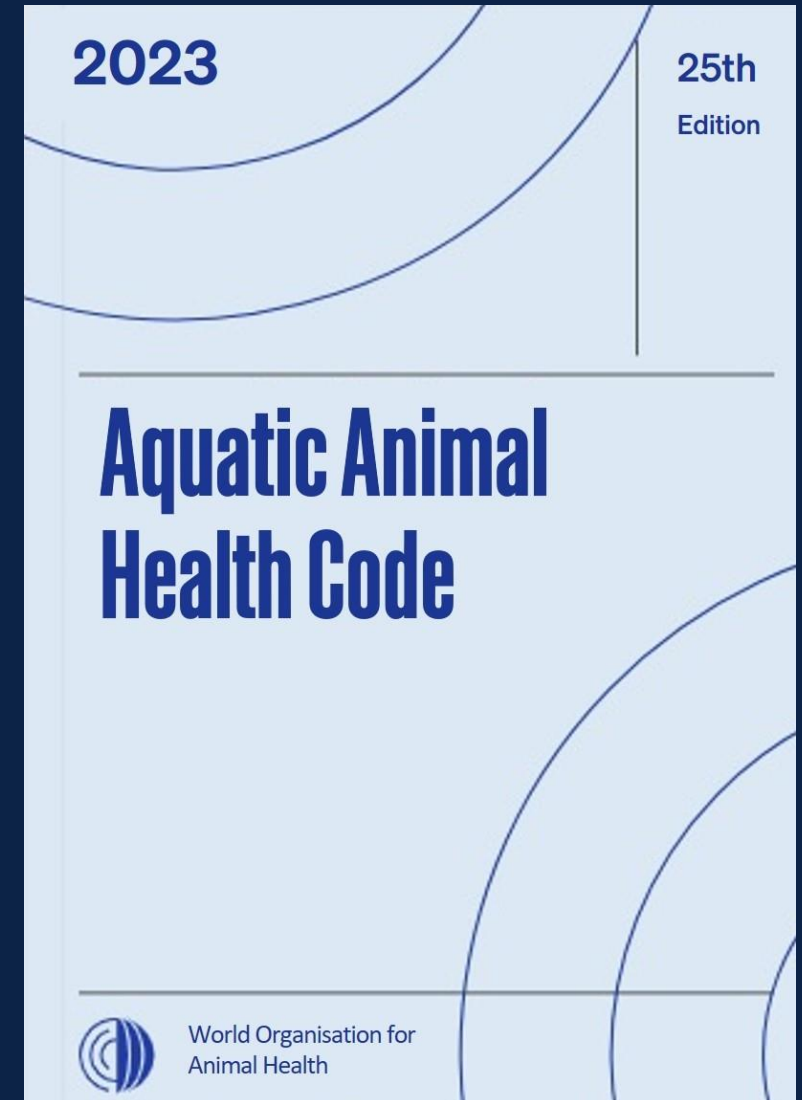


**“If you can’t
measure it,
you can’t
manage it”**

Peter Drucker

WOAH standard for an EDS

	Criteria	
1	Awareness of farmers and others of signs of listed diseases	☒
2	Recognition and Reporting: vets and AAH professionals trained in detection and reporting	☒
3	Investigation: capacity of AAHS to rapidly and effectively investigate an outbreak	☒
4	Diagnosis: lab capacity to confirm disease	☒
5	Legal obligation to report suspicion of listed diseases	☒





WOAH PVS tool - aquatic

II 4 surveillance and early detection

The authority and capability of the AAHS to determine, verify and report on the sanitary status of aquatic animal populations, including wild aquatic animal populations, in a timely manner.

Level 1:

The AAHS have very limited passive surveillance capacity, with no formal disease list, little training/awareness and/or inadequate national coverage. Disease outbreaks are not reported, or reporting is delayed.

Level 5:

The AAHS have comprehensive passive surveillance nationwide, providing confidence in the country's notifiable disease status in real time. The AAHS routinely report surveillance information to producers, the industry and other stakeholders. Full epidemiological disease investigations are undertaken in all relevant cases with tracing and active follow up of at-risk establishments

Barriers to disease reporting



Key issue

Animal health surveillance systems typically have been designed to meet high-level government informational needs, and any incentives for those who generate data (...) to report surveillance information are sometimes outweighed by the negative consequences of reporting; **underreporting is a serious constraint.**

Preventive Veterinary Medicine 167 (2019) 169–173

Contents lists available at ScienceDirect

 ELSEVIER

Preventive Veterinary Medicine

journal homepage: www.elsevier.com/locate/prevetmed



Discussion

New approaches to aquatic and terrestrial animal surveillance: The potential for people and technology to transform epidemiology

Jennifer Hutchison, Catriona Mackenzie, Ben Madin, Jonathan Happold, Edwina Leslie, Emma Zalcman, Anne Meyer, Angus Cameron*





People matter in animal disease surveillance: Challenges and opportunities for the aquaculture sector

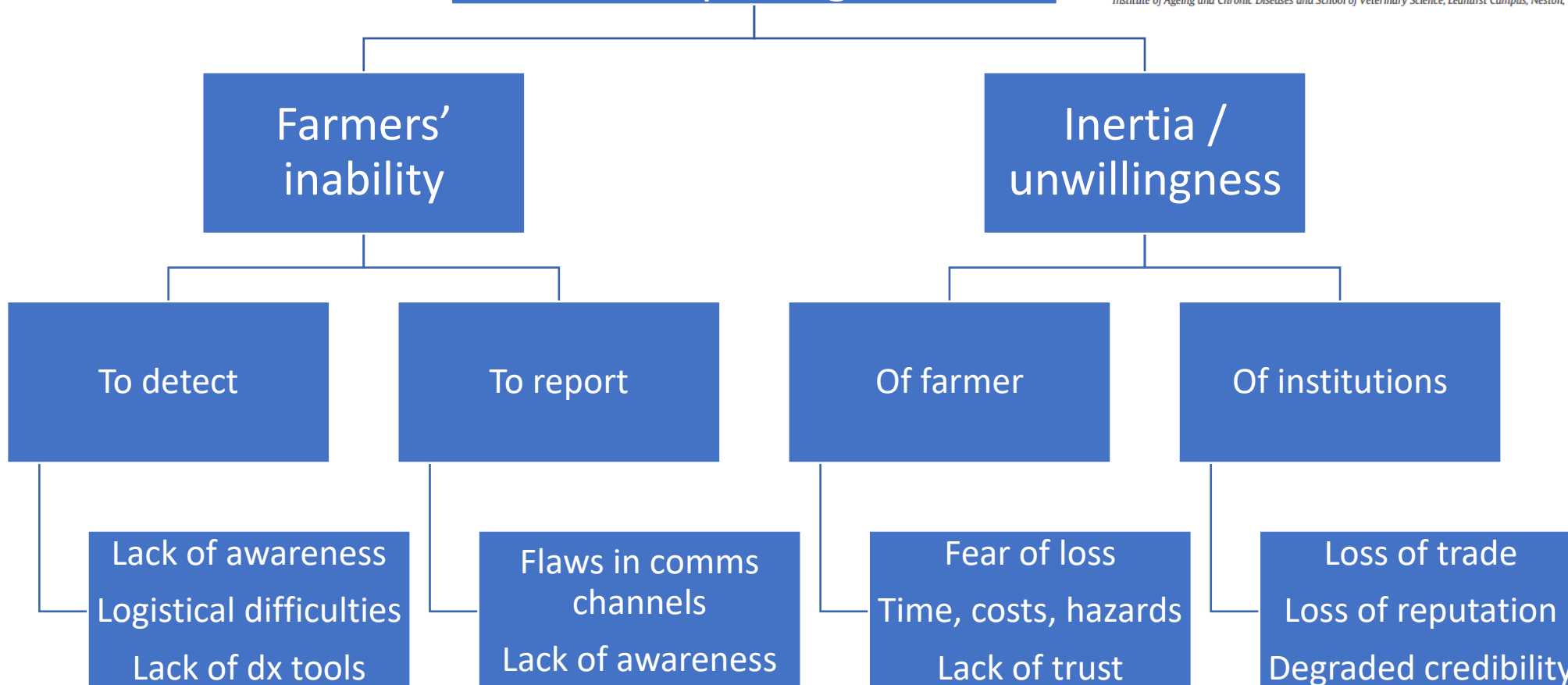
Cecile Brugere ^{a,*}, Dennis Mark Onuigbo ^b, Kenton Ll. Morgan ^c

^a Soulfish Research and Consultancy/Stockholm Environment Institute, c/o Environment Building, Wentworth Way, University of York, Heslington, York YO10 5NG, United Kingdom

^b School of Postgraduate Studies, Department of Agricultural Economics, Institut Pertanian Bogor, C/o Gedung Sekolah Pascasarjana Lt.1, Jl. Raya Darmaga Kampus IPB Darmaga, Bogor, 16680, West Java, Indonesia

^c Institute of Ageing and Chronic Diseases and School of Veterinary Science, Leahurst Campus, Neston, Wirral, CH64 7TE & Apex Building, West Derby St., Liverpool, United Kingdom

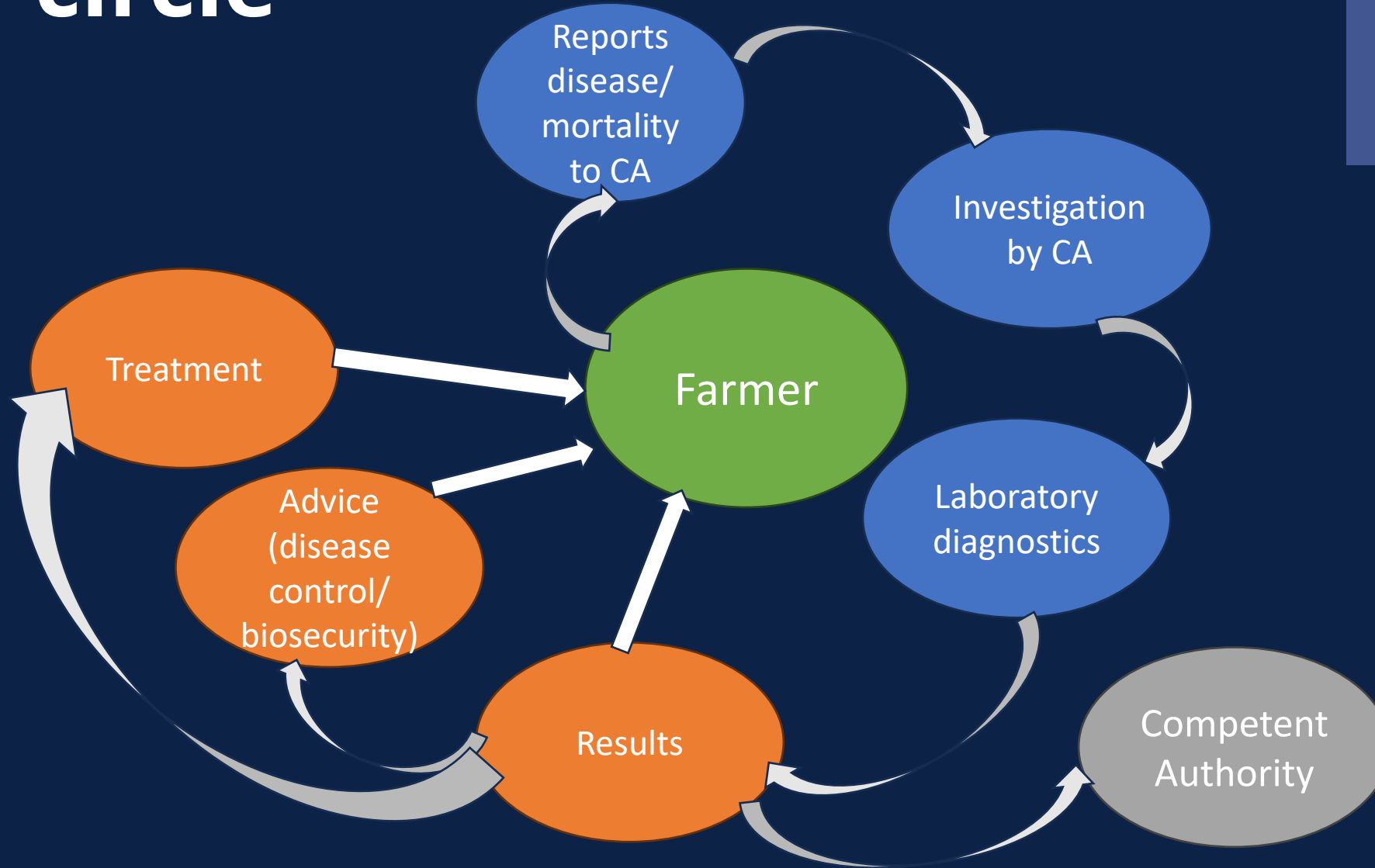
Reasons for poor reporting and unrepresentative reporting



**How can early
detection be
improved?**



Creating a virtuous circle

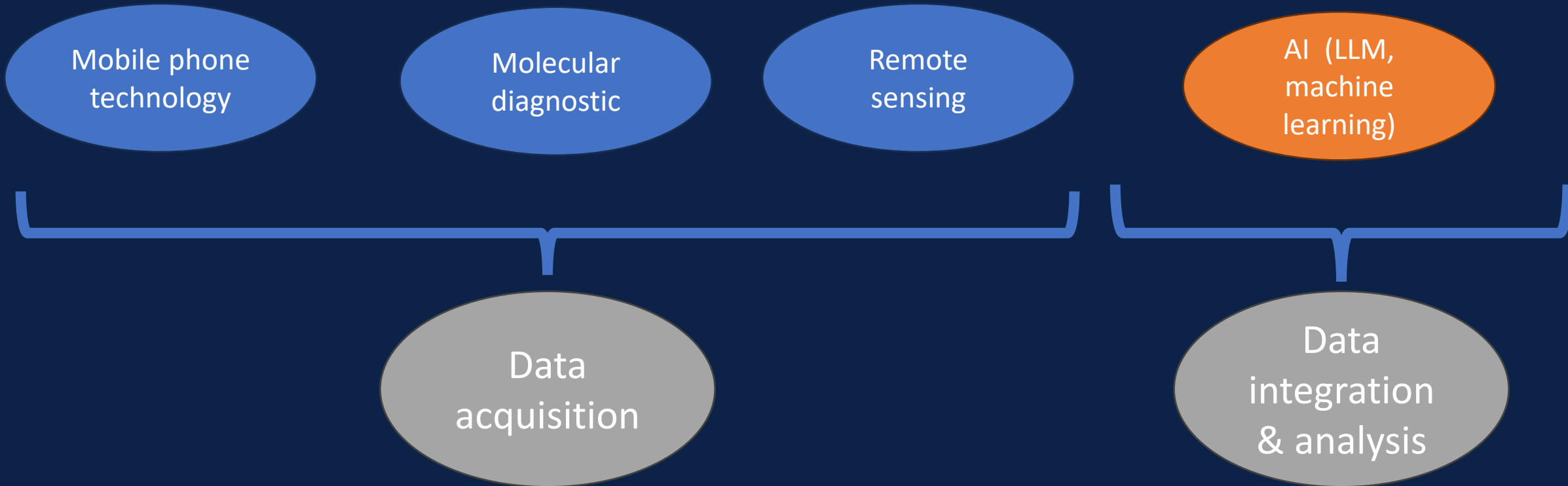


That reporting will result in

- Investigation
- Diagnostics
- Results, advice and possibly treatment being provided to the farmer

Application of technology

For early detection of aquatic animal diseases



Mobile phone technology

..... and associated databases

Reporting must be made easy, for example, through mobile phone apps or SMS



EMA-i (Event Mobile Application):

Developed by the FAO: mobile app allows veterinary field officers to submit geo-referenced reports from the field, feeding data into national surveillance platforms



UiO : HISP Centre
University of Oslo



dhis2

DHIS2 is a tool for collection, validation, analysis, and presentation of aggregate and patient-based statistical data, tailored (but not limited) to integrated health information management activities

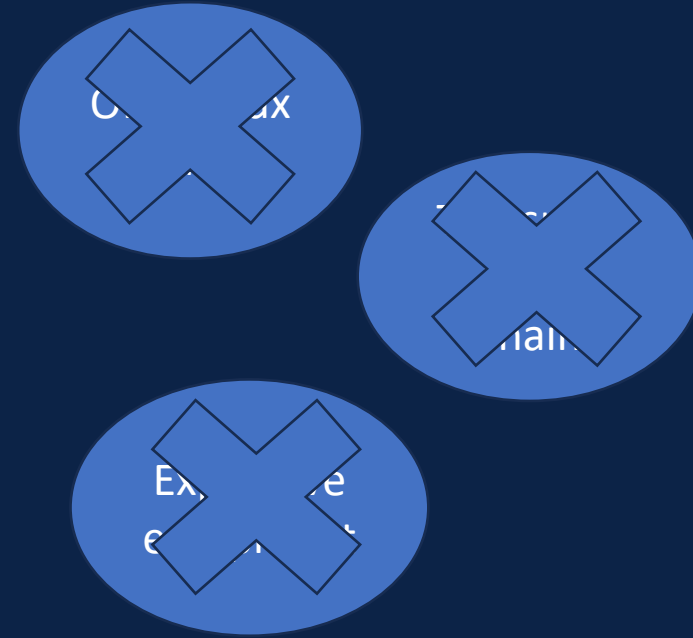
Diagnostics

Key advances

- Pond-side technology for on site microbial detection
- Field compatible molecular methods
- Use of environmental samples

Emerging technologies

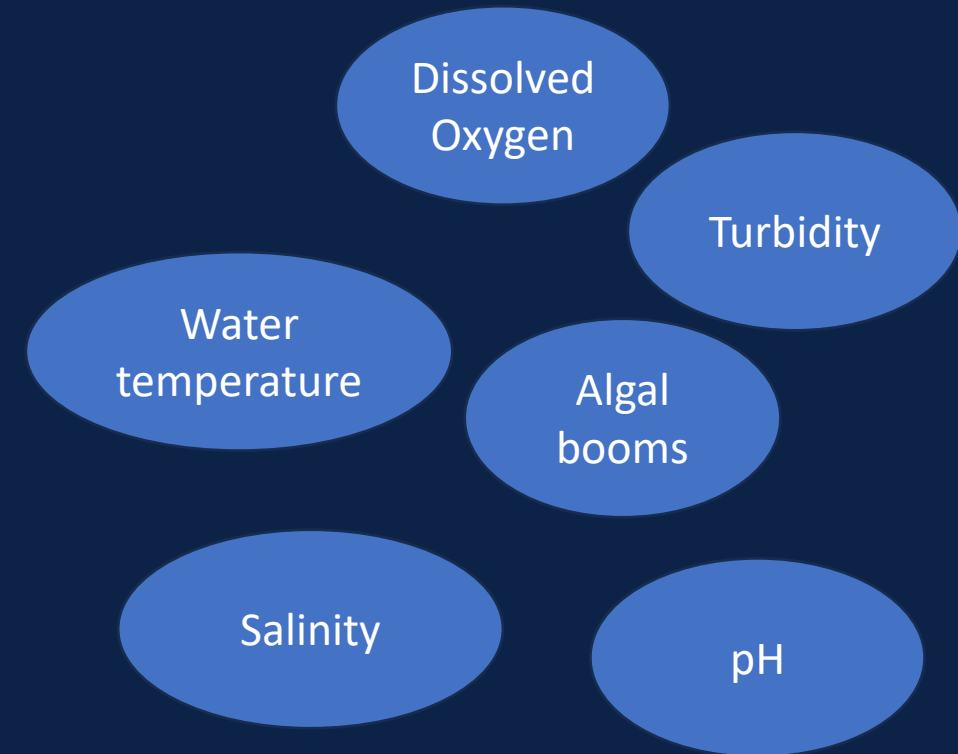
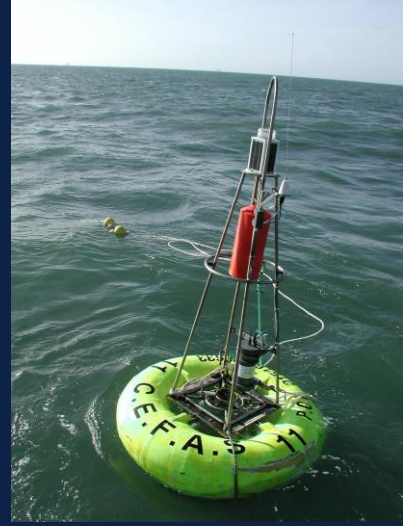
- CRISPR-Cas technology for precise pathogen detection
- Sequence-based community analysis for microbial monitoring



Remote sensing

Smart buoy technology

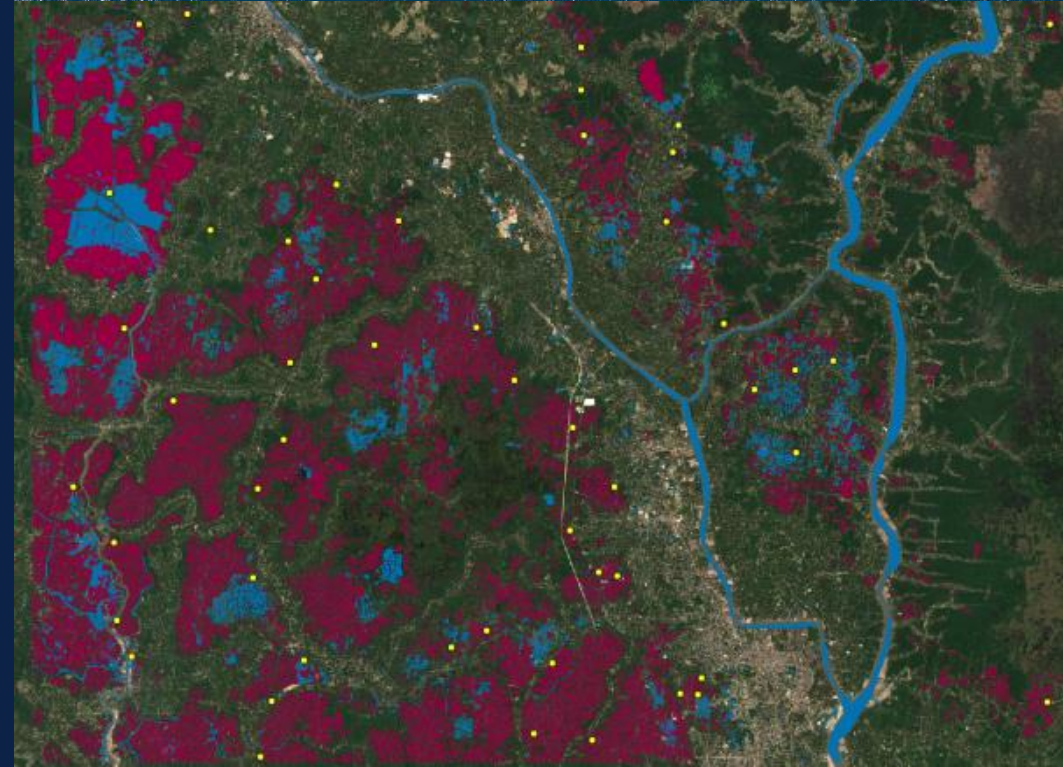
- Autonomous monitoring systems
- High frequency measures of physical, chemical and biological parameters
- On board computer allows for real-time data processing
- Data transmission via satellite
- Applied in the marine environment

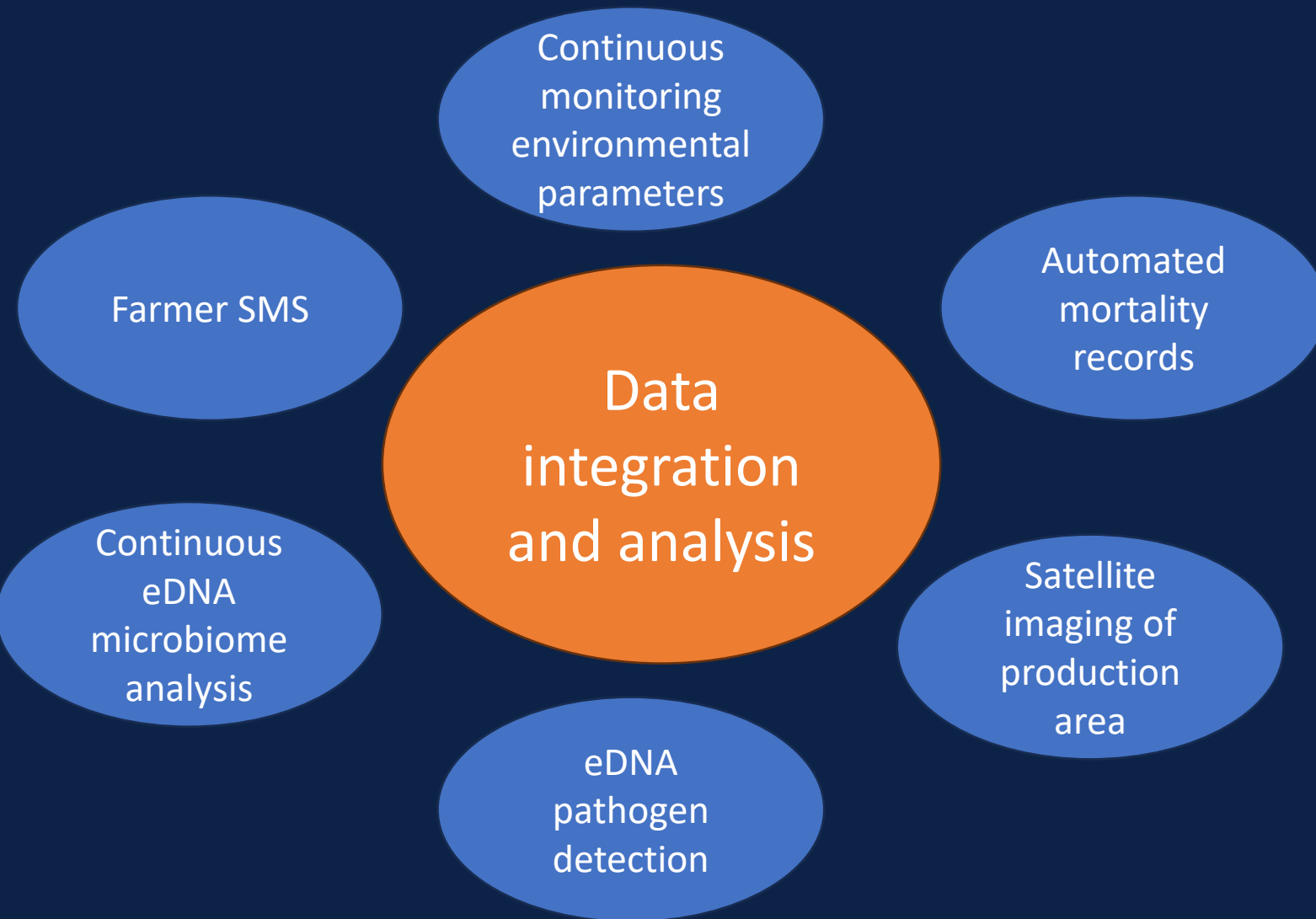


Denominators

Where are farms?

- Information on location and type of farm is crucial to planning surveillance and disease control programmes
- Many countries have incomplete inventories of aquaculture businesses
- Aerial or satellite imaging can be used to locate and categorise aquaculture businesses and estimate production





Machine learning is a field of artificial intelligence that enables systems to learn from data, identify patterns, and make decisions with minimal human intervention

Conclusions



Conclusions

- Farmer reporting remains central to early detection
- The needs to farmers must be central to the design of surveillance systems
- Early detection achieves little unless it initiates i) disease investigation, ii) support to farmers and iii) measures to prevent spread and potentially eliminate infection.
- Farmer reporting can be enhanced by the application of new technology
- The integration of remote sensing, molecular technologies, satellite transmission and machine learning potentially provide additional sources surveillance information

Acknowledgements

Defra FB001 contract

Cefas colleagues:

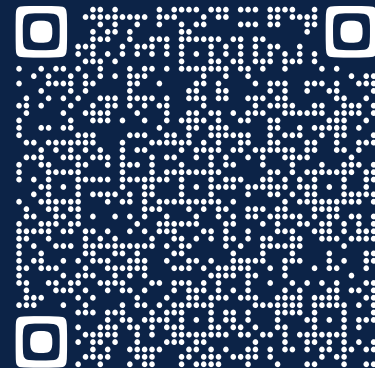
Mark Thrush, Jess Witt, Mickael Teixeira Alvers,
Joanna Howells

WOAH Aquatic Animal Commission

Thank you



ed.peeler@cefas.gov.uk



Find out more about
WOAH CCEAAD



Centre for Environment
Fisheries & Aquaculture
Science



Cefas

WOAH Collaborating Centre for
Emerging Aquatic Animal diseases

Reference Centre



World Organisation
for Animal Health
Founded as OIE